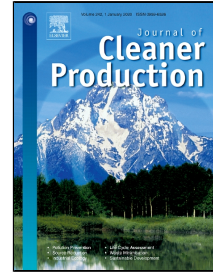


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Competitive Advantage Implication Of Different Product Service System Business Models: Consequences Of 'Not-Replicable' Capabilities



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# COMPETITIVE ADVANTAGE IMPLICATION OF DIFFERENT PRODUCT SERVICE SYSTEM BUSINESS MODELS: CONSEQUENCES OF ‘NOT-REPLICABLE’ CAPABILITIES

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## Abstract

For many companies, the servitization of business grounded on Product Service Systems is proving to be a winning value proposition based as it is on a distinctive mix of economically, socially and environmentally sustainable solutions aimed at satisfying customer's needs.

This research investigates the conjoint effect of three potential sources of PSS's competitive advantage: the type of PSS, i.e. a value proposition directed at a market segment based on specific customer behaviour, the core resources, competences and organizational processes on which the PSS's business model is based and their level of protection from competitor's replication.

We adopted a multiple case study methodology to take into account the complex interrelation of the variables characterizing the phenomenon investigated by sampling 10 companies and collecting data by means of semi-structured interviews. Results of within- and cross-case analysis reveal that Use-Oriented PSS business models gain a competitive advantage from physical resources and organizational processes, whether protected against replication threat or not, while Result-Oriented PSS business models from people competences. Human capital is fundamental also for Product-Oriented PSS business models, but companies can reach a competitive advantage only if protected against replication threat from competitors.

The paper contributes to the expanding PSS literature by identifying potentially distinctive factors of the PSS business model and by providing useful considerations on PSS competitive and strategic potential, with an in-depth analysis of success elements.

**Keywords:** Product Service System, Business Model, Competitive Advantage

## 1. Introduction

The Servitization of business refers to a shift from an exclusive focus on products or an exclusive focus on services toward integrated systems or bundles of products and services, with services playing an ever more relevant role as compared with products (Vandermerwe and Rada, 1988). Servitization can be based on a Product Service System, “a business model focused toward the provision of a marketable set of products and services, designed to be economically, socially and environmentally sustainable, with the final aim of fulfilling customer’s needs” (Annarelli *et al.*, 2016: 1017). The integration of products and services can bring a non-negligible innovative potential, securing competitiveness while at the same time allowing companies to address environmental concerns and provide more sustainable offerings on the market. Indeed, PSS brings within it an incentive for companies to prolong the useful products’ life cycle, so as to ensure a better exploitation of physical resources and offering customers a more satisfactory experience (Tukker, 2015).

Although there has been substantial research into Servitization and PSS for more than 20 years, there are still some important gaps concerning the analysis of the strategic value of PSS and its ability to constitute a value proposition (Baines *et al.*, 2017; Kuijken *et al.*, 2017). It is essential to investigate the current role of PSS as a value proposition and, to this end, evaluate the competitive advantage obtained by firms thanks to PSS implementation (Lightfoot *et al.*, 2013).

In their review, Annarelli *et al.* (2016) show that only a small number of papers (if compared to the total academic production on PSS) (~10%) have provided an analysis of PSS’s competitive potential. A considerable amount of contributions investigated the sustainability potential. Baines *et al.* (2007) underlined the impact of PSS on environmental dimension of sustainability: the reduction of consumption of inputs, of waste production and of public pressure on environmental issues. Lee *et al.* (2012) highlighted that PSS can impact positively on social sustainability by improving customers’ quality of life, comfortability of living environment, income level and health status. As regards the empirical base, some authors have focused on manufacturing firms. Azarenko *et al.* (2009) conducted a demonstration case study to investigate the feasibility of PSS for machine tool providers operating in a B2B context. Rese *et al.* (2009), in order to estimate the value of PSS for an individual customer, developed a tool combining two different approaches (Net Present Value and Real Options Approach). Other authors, like Friebe *et al.* (2013), have focused on different industries, in this case that of solar energy systems. Alfian *et al.* (2014) conducted a case study in the car-sharing industry with demand data from the city of Seoul, in South Korea. Another industry that has attracted the interest of some authors is that of defence and aerospace. Bankole *et al.* (2012) focused on the topic of affordability, reviewing this topic and its state-of-the-art in the context of PSS and aerospace, through a double review of the literature and industrial practice. Chirumalla *et al.* (2013) also focused

on the aerospace industry: they adopted a qualitative research methodology “characterised by a case-study approach in one case and by an action research approach in the second” (p. 154). Annarelli *et al.* (2018) proposed a methodology for quantitatively evaluating non-economic advantages and disadvantages coming into play in PSS adoption by using a Servitization Value Correction Coefficient (SVCC) that adjusts the Economic Value Added (EVA) in six case studies.

These results make it clear that investigating PSS performance from different perspectives, and considering several distinctive elements, is key for understanding PSS’s potential and capability of generating a competitive advantage for firms. The papers cited above investigated PSS from different perspectives and examined cases from different realities: the main drawback is that they have always focused on a single industry and/or very similar firms operating in different industries, but with many similarities. A few authors have examined different cases of PSS together, but those who have done so did not focus on aspects closely related to competitiveness and sources of competitive advantage.

The main drawback is that they have provided analyses focused on forecasting potential performance, while there is a lack of contributions employing a “backward perspective”, to examine results reached thanks to PSS implementation, rather than considering what can be potentially done. Forecasting means that research until today has mainly focused on analysing PSS competitive and economic perspectives: the aim was that of looking at future scenarios for PSS implementation and development, designing methods and tools to predict the impact for businesses.

These considerations have been under-examined in some past works, and have always been focused on specific firms operating in particular sectors. As evidenced also by Qu *et al.* (2016), there is still a great need for “research to demonstrate PSS influence on society, economy, and environment”, implementing “different points of view from the usual ones: knowledge management, business models, technology, barriers, policy” (p.12).

Moving toward this research direction, Kindström (2010) conducted a multiple case study in manufacturing companies to investigate how companies can take competitive advantage from service-based business models. This work focused on the service components of the offering, lacking a wider view on servitized offerings, and it was conducted exclusively on manufacturing companies. Looking at the service industry, Rau *et al.* (2017) investigated how new servitized value propositions (built through service design thinking) can provide competitive advantage to companies, but even if really valuable the study focused on a single case and adopted a forward perspective. Raddats *et al.* (2017) brought a new dyadic perspective into capabilities for competitive advantage of servitized firms by studying seven dyadic relationships in five different sectors: this study addressed the evidenced gap, but focused more on capabilities and conducted an exploratory study rather than a theory building effort.

The exploration of the literature above reveals a lack of significant cases stratified according to different variables and aspects, thus highlighting the need for such research. Our research aims to investigate the conjoint effect of three potential sources of PSS's competitive advantage: the type of PSS, i.e. a value proposition directed to a market segment based on a specific customer behaviour, the core resources, competences and organizational processes on which the PSS's business model is based and their level of protection from competitor's replication. The aim of this work is therefore to investigate PSS's actual contribution in reaching firms' strategic goals, exploring if it really could be a successful proposal, bringing competitive advantage, and making the PSS worth implementing and developing (Baines *et al.*, 2017).

This aim derives from the following research questions:

*RQ1: How can Product Service System's types and core resources/competences/organizational processes lead to a competitive advantage?*

*RQ2: How can protection from competitors' replication ensure a competitive advantage of a Product Service System in relation to different types and core resources/competences/organizational processes?*

To answer these research questions, we adopted the case study methodology to take into account the complex interrelation of variables characterizing the PSS phenomenon and its performance in terms of strategic goals and competitiveness (Rönnerberg Sjödin *et al.*, 2016).

The paper is organized as follows. Section 2 first discusses the relevant theoretical background and then presents the theoretical framework derived from literature, discussing the different variables investigated, i.e. (1) type of PSS, (2) core resources/competences/organizational processes and (3) protection from replication and competitive advantage. Section 3 presents the research methodology, a multiple case studies analysis. In section 4, we present and discuss results following the theoretical framework, together with the three propositions emerging from the investigation. Finally, in section 5 we summarize contributions and limitations of the research, together with possible future research directions.

## **2. Theoretical background**

### ***2.1. Sources of PSS's competitive advantage***

The economic and strategic potential of PSS can be related to market value for users, costs for providers, capital needs, and the ability to sustain value in the future, giving the first important indications of PSS potential linked to strategic issues (Tukker, 2004). A company's competitive advantage influences, and is influenced by, the competitive context and derives from valuable, rare,

non-fully imitable and imperfectly substitutable firm-specific resources (Barney, 1991) and organizational processes (Teece *et al.*, 1997). Furthermore, resources constitute a series of factors converted into final products and services, and can be distinguished in physical capital, human capital and organizational capital (Barney, 1991; Amit and Schoemaker, 1993) In this sense, even successful PSS business models should be strategically aligned with market segments and should be based on inimitable resources, competences and organizational processes. Consequently, distinctive sources of PSS's competitive advantage could be:

- The type of PSS, i.e. a value proposition directed to a market segment based on a specific customer behaviour;
- The PSS's core resources, competences and organizational processes, i.e. key factors on which the value proposition is based;
- The level of protection from replication, i.e. the threat of replication and imitation, of resources, competences and organizational processes.

#### *2.1.1. Types of PSS, market segmentation and competitive advantage*

The existence of different market segments indicates the presence of different groups of customers with very different ideas regarding the product's property (Tukker and Tischner, 2006), different cultural attitudes and different established habits (Manzini and Vezzoli, 2003). Thus, one approach used to define the segments since the PSS introduces changes in terms of ownership, responsibility, accessibility and costs, considers the different habits of the customer. Focusing on the right segment with the right value proposition is a crucial factor for the success of the PSS (Kindstrom, 2010); and not all value propositions are suitable for all customers (Rexfelt and Hiort af Ornas, 2009).

In PSS, since value creation must be understood through the customer's gaze (Davies 2004), achieving an excellent understanding of the client, of his business, and its operational activities becomes critical (Reim *et al.*, 2015). Consequently, the company should collect and analyse data and information regarding the problems and the operating activities of the client in order to create and transmit a clear formula of value that meets the real preferences and needs. Once the needs of a client are understood, the company can influence them (Payne *et al.*, 2008). Furthermore, the company must develop a specific strategy for the segment, including business objectives, by implementing different methods to segment and analyse customer needs. In particular, in the PSS context, companies need to develop specific value proposals for each client, which are therefore unique, defining customers for different markets and segments (Storbacka, 2011).

The most widely accepted and reported categorization of PSS is based on the object of the contract and the shift in ownership (Tukker, 2004). In the first category, named Product-Oriented PSS, the

focus is on the product, i.e. the PSS is oriented toward product selling, with extra services added to the offering. With the Use-Oriented PSS the attention shifts from selling the product to giving access to its usage: this gives different customers access to the same product in a limited time span, based on different forms of renting and/or sharing. The third category proposed is focused on the result provided by the product, as the name Result-Oriented PSS implies. In this case, the producer/provider maintains the ownership of the product, and we can therefore state that the usage of the product itself is in some way outsourced by the customer. As already highlighted by Lightfoot *et al.* (2013) these three typologies clearly depict different value propositions lying at the core of PSS business models, remarking their usefulness in describing the organizational positioning. Therefore, these typologies allow to perform a *market segmentation based on customer behaviour*:

- Product-oriented: this segment includes all those customers who wish to remain in possession of the asset, even at the cost of major disbursements in financial terms, but who have decided to outsource maintenance, as, for example, a company who owns plants for the production of electricity and who decide to buy the main components such as heat exchangers or turbines, but prefer to entrust the maintenance to their producers.
- Use-oriented: in this segment are included all those customers who do not want to sustain a high initial outlay, even at the cost of not being the owners of the asset. Such, for example, are all the companies that lease means of transport, or instruments of various kinds. Among the incentives that push customers to place themselves in this segment, is the possibility of VAT benefits.
- Result-oriented: in this type of segment are included all those customers who are not interested in owning the good or using it, but to exclusive use of the results produced by it. In this way, it is possible for the client not to have fixed assets related to the asset on the balance sheet.

### 2.1.2. PSS's core resources/competences/organizational processes and competitive advantage

Investigating PSSs' competitive advantage from a Resource-based point of view (RBV) and distinguishing the relevant elements, can be a good strategy for understanding PSS's potential and capability in generating revenues for firms and creating a sustainable business model, as already highlighted by Baines *et al.* (2017). In fact, according to the Resource-based theory, management deems some firm-specific *resources* to be crucial in explaining a firm's performance (Amit and Schoemaker, 1993). Teece *et al.* (1997) added managerial and organizational *processes* because a firm's competitive advantage lies in these processes, shaped by its (specific) asset position, and the paths available to it. Therefore, from this perspective we can consider three distinctive factors: (1) tangible resources (the physical capital identified by Barney, 1991), (2) intangible resources or



competences (the human capital) and (3) organizational processes.

A well-designed mix of physical resources and human resources is at the core of a PSS's effectiveness. Tangible resources refer to the whole system dictating the physical part and the service necessary to develop a successful PSS, while intangible resources refers to intellectual and social capital and information, managed through ICT and digital technologies. The last ones are fundamental for implementing and supporting PSS (Becker *et al.*, 2013; Ardolino *et al.*, 2018). To undertake the implementation of the PSS systems and service provision, human resources and their competences are key resources, so it is not surprising that PSS providers invest considerably in human capital (Tan and Mcaloone, 2006).

Finally, also organizational processes play an important role in terms of effectiveness and efficiency. Moreover, in the PSS context, companies collect data on the use of their assets and on the functioning of their processes, thus obtaining a unique source of information that is impossible to replicate for competitors. Thanks to digital technologies, this practice has expanded further with the spread of so-called smart products that make it possible to obtain real-time data (Porter and Heppelmann, 2014).

### 2.1.3. *Protection from replication and competitive advantage*

In addition to the nature of the elements constituting competitive advantage, another important point concerns their sustainability over time. This aspect is closely related to the concepts of Replicability and Imitability, as explained by Teece *et al.* (1997): the first involves the “transferring or redeploying” of resources and/or capabilities from an economic setting to another; the second is simply replication performed by a competitor. According to the literature, *Replicability and Imitability* are usually used as an index of threat to competitive advantage's sustainability over time.

Indeed, even if every company can develop its own set of capabilities, i.e. competences and resources that may ensure a favourable competitive position (competitive advantage), they must also be difficult to imitate (Teece *et al.*, 1997). If competitors can easily replicate or imitate a distinctive feature on which the competitive advantage is built, the whole set of resources, routines and skills related to this can result in the loss of its distinctive value. However, specific sets of resources and competences, and routines upon which they are built, are often quite hard to replicate: the replication effort, indeed, brings with it a double difficulty that involves, first, the identification of relevant routines, and then their actual replication. Furthermore, many routines, resources and competences are attributable to a firm's specific contextual factors, as for instance local or regional forces that shape the company's set of strategic choices over time (Barney, 1986; Dierickx and Cool, 1989; Maritan and Peteraf, 2011). Another key element that can explain company-specific resources and

competences, as opposed to local and regional forces, is the role of firm-specific history (Nelson and Winter, 1982), which might affect and shape the set of a company's strategic choices.

## 2.2. *Theoretical framework of analysis*

Given the considerations above and on the basis of previous results documented in the literature, we structured our framework to analyse PSS.

A first introductory part aimed to gather general information on the firm and the PSS(s). From previous work on PSS, we adopted indicators to describe and give an overview of the current situation of each case: for each PSS we took note of the industry in which the firm is operating, the original offering/business model before PSS introduction, the type/category of PSS (Tukker, 2004), the characteristics of the development project (for example, if it was launched as an internal project or a joint venture) and the reasons behind PSS adoption. Following the theoretical sampling principles reported above, and mapping firms according to these characteristics we could analyse them from different perspectives. Moreover, from the PSS literature (Goedkoop *et al.*, 1999; Cook *et al.*, 2006; Azarenko *et al.*, 2009; Tonelli *et al.*, 2009; Lockett *et al.*, 2011; Cook *et al.*, 2012; Schotman and Ludden, 2014; Overholm, 2017) the importance of understanding the internal and external environment emerged. As regards the internal environment, the goals were that of understanding the *degree of awareness* about PSS, and also possible *resistances to change*; while for the external environment (related to firm's boundaries and PSS's specific business model), our attention was mainly focused on *stakeholders' awareness/acceptance* of PSS, and their role in the PSS offering/business model.

The main part of the analysis framework derived from literature dealing with strategic management and competitive advantage topics (Barney, 1991; Amit and Schoemaker, 1993; Teece *et al.*, 1997; Teece, 2010).

We focused the analysis of case studies on the presence (or absence) of a *Competitive Advantage* attributable to PSS offering(s), the *Competitive Advantage* being the dependent variable we investigated. During the interviews, we wanted to understand if, in the opinion of the interviewee, the PSS was a concrete and distinctive source of *Competitive Advantage*. According to *RQs* the main idea behind this variable was to understand if, first of all, the company was in a "favourable competitive position" ensured by a competitive advantage, in order to further investigate the nature of this advantage, namely its constitutive elements, and its sustainability over time.

In order to fully understand the sources of this advantage (if any) and to understand the main components lying behind the successful (or unsuccessful) implementation of PSS, we modelled our analysis according to the *Resource-based view (RBV)*: we focused on *resources*, *competences*, and

*processes* as the core elements of a competitive advantage. Then, we wanted to understand the *ease of retrieval*, the *dedicated investments*, and their nature of *opportunities* and/or *risks*: this information allowed us to correctly evaluate the importance of each element of the *RBV* for the analysed cases. Indeed, the more a certain *resource/competence/process* is easy to be retrieved, the smaller is the investment, or the more it is a risk (rather than an opportunity), the less it is likely to bring a competitive advantage and play a key role in companies' strategy development. Most importantly, we addressed the key issue of the competitive advantage's sustainability over time by studying the *Protection from replication degree* of the elements above (Teece *et al.*, 1997).

Summarising, we identified three distinctive factors of PSSs business models for investigating their effect as determinants of competitive advantage:

- (1) *Type of PSS (market segmentation)*. PSS can be classified according to Tukker's categorization (2004) of Product-Oriented, Use-Oriented, Result-Oriented PSS. This categorization has always been considered a central point in research on PSS: some authors have proposed different categorizations as an alternative or an expansion of this one, but scholars mainly agree on the need to categorize and distinguish the various forms of PSS. According to the literature nowadays it is impossible to analyse PSS implementation and its performance without considering its various categories, first of all, to ensure a well-stratified sample of cases (as reported above) and, most importantly, because it is an important variable according to the aims of our analysis, following Reim *et al.* (2015).
- (2) *PSS's core resources/competences/processes*. According to the Resource-based view model, management deems some firm-specific resources, competences and organizational processes to be crucial in explaining a firm's performance (Amit and Schoemaker 1993; Teece *et al.*, 1997). So, we asked the interviewees to analyse their PSS-based business model trying to decompose it and understand its relevant foundational elements, distinguishing between Tangible resources (R), Intangible Resources or Competences (C) and Internal/Organizational Processes (P).
- (3) *Protection from replication*: an important point concerns sustainability of competitive advantage over time, which is closely related to the concepts of replicability and imitability, as outlined by Teece *et al.* (1997): the first involves the "transferring or redeploying" of resources and/or capabilities from one economic setting to another; the second is simply replication performed by a competitor. following the literature, we decided to use *protection from replication* as an index of a competitive advantage's sustainability over time. Then we asked each interviewee to evaluate the degree of *replication* of R/C/P foundational elements of PSS. We divided the qualitative judgements and feedbacks of these managers into three categories: hard degree of replication for competitors (the most desirable feature), medium degree of replication, easy degree of replication.

The medium degree meant that the resource, the competence, or a specific process, could easily have been replicated under normal conditions, but because of some particular choice of the firm under analysis it became quite hard to replicate (e.g., first mover's advantage). We assigned a score to each R/C/P according to the ease of replication: 0 for easy replication, 0.5 for medium replication, and 1 for hard replication. The sum of the three values gives a *protection from replication index* for each PSS.

### 3. Materials and methods

The case study is the preferred method to investigate an empirical topic by following a set of pre-specified rules and procedures; it allows a holistic and contextualized analysis, properly suited for exploratory research purposes, because it allows the identification of crucial variables while exploring a given phenomenon. In particular, this research employed a multiple case study design, because "it allows both an in-depth examination of each case and the identification of contingent variables that distinguish each case from the other" (Yin, 1984; Eisenhardt, 1989). Moreover, the essence of a case study is that it tries to illuminate a decision or a set of decisions: why they were taken, how they were implemented, and with what result (Schramm, 1971).

Considering that PSS is not a new topic but has been developed extensively over the years, the existing theoretical background was a solid base upon which to build and organize the research (Yin, 1984; Huberman and Miles, 2002). For this research, there was no need for exploratory efforts with a grounded theory approach, and case studies have been designed as an inductive theory building effort, in line with the findings emerging from the previous literature. This theory building approach is suited to the identification and description of the key variables, the linkages between them, and the reasons behind these correlations. In doing this, the case study followed a variance theory approach (Mohr, 1982).

The case studies were designed in order to ensure a high quality of research and methodological rigor. In order to reduce possible biases, and to maximize validity and reliability, the objective of the research was to diversify data collection methods and sources (Yin, 1984; Eisenhardt, 1989; Patton, 2002). Documentation included mainly primary data from semi-structured interviews and secondary data (e.g. archival data from companies' websites). Data collection for this first step of research, including also the process of retrieving cases, required 2 to 3 months.

The study involved ten firms (Table 1), operating in different industries and involving different categories and three types of PSS, i.e. Product-Oriented (PO), Use-Oriented (UO), Result-Oriented (RO) (Tukker, 2004), differing also in terms of dimensions. In this way, it was possible to study different realities inside the same phenomenon. The chosen approach has been that of theoretical

sampling (Eisenhardt, 1989; Eisenhardt and Graebner, 2007). Furthermore, the selection of cases was oriented toward “extreme cases and polar types” with the aim of extending theory (Pettigrew, 1988; Eisenhardt, 1989). While selecting cases, we wanted to maximize the degree of information that could be extracted. Accordingly, in the first steps of cases selection, we conducted a pre-selection screening of companies based on secondary data (mainly retrieved from previous studies, companies’ websites and reports as well) to ensure that companies involved in the study would attain to our selection criteria. Starting from the research questions, we wanted, first of all, to analyse cases of the three different PSS categories, in order to highlight the influence of each category in diverse contexts; for this reason, we also wanted to select cases operating in industries where PSS can be considered a necessary competitive feature (PSS\_3, PSS\_5, PSS\_8) or a distinctive competitive feature (PSS\_1, PSS\_2, PSS\_4, PSS\_6, PSS\_7, PSS\_9, PSS\_10), resembling the concepts of *order-qualifier* and *order-winning criteria* (Hill, 1994). In case selection, we also considered companies operating in industries where the Circular Economy can (or cannot) play a key role. Finally, another characteristic that we considered in case sampling was the nature of markets where firms operate: we selected cases from companies operating in mature markets (PSS\_1, PSS\_2, PSS\_3, PSS\_4, PSS\_5, PSS\_8) and in new developing markets (PSS\_6, PSS\_7, PSS\_9, PSS\_10).

**Table 1. Sample of selected PSSs**

	Country	Industry	Net sales	Size	Category	Competition	Market
<b>PSS_1</b>	U.S.	Textile	€ 215 mln	MNC	PO	DF	MM
<b>PSS_2</b>	U.S.	Textile	€ 215 mln	MNC	RO	DF	MM
<b>PSS_3</b>	Sweden	Household appliances	€ 12.92 bln	MNC	PO	NF	MM
<b>PSS_4</b>	U.S.	Advertisement	€ 742 mln	MNC	UO	DF	MM
<b>PSS_5</b>	Japan	Material handling	€ 1.8 bln	MNC	PO	NF	MM
<b>PSS_6</b>	Italy	Mobility	NA	SME	UO	DF	DM
<b>PSS_7</b>	Swiss	Engineering	€ 1.9 bln	MNC	RO	DF	DM
<b>PSS_8</b>	U.S.	ICT	€ 5 bln	MNC	RO	NF	MM
<b>PSS_9</b>	Italy	Coworking Spaces	NA	SME	UO	DF	DM
<b>PSS_10</b>	Netherland	Smartphone	NA	SME	PO	DF	DM

MNC: Multinational Company; SME: Small-Medium Enterprise; PO: Product-Oriented PSS; UO: Use-Oriented PSS; RO: Result-Oriented PSS; NF: PSS as a Necessary Feature; DF: PSS as a Distinctive Feature; MM: Mature Market; DM: Developing Market

For each of the involved firms, we carried out a semi-structured interview with a key informant (typically a high-level manager) who had an all-encompassing perspective on the total PSS offering: the first part of the interview protocol focused on classifying firms and gathering more general data about PSS implementation and the reasons behind its adoption; then each interview was structured in

sections according to the *Key Factors* used for the framework of the analysis that will be detailed below. Together with interviews, we collected and analysed secondary data to support what stated by the key informants, to allow data triangulation (as reported in Table 2); furthermore, these data played a key role also in allowing us to measure the degree of *protection from replication* and to prove the presence (or absence) of a competitive advantage ensured by PSSs

Starting from the analysis of previous case studies published in the literature on PSS, we selected our set of firms: given the gap evidenced in section 2, the aim was to reconsider PSSs previously presented in the literature with a “forward perspective”, whose potential was forecast with ex-ante analyses. This selection process assured us a stratified set of firms, well differentiated according to the metrics of interest: firm’s size, industry, type of PSS adopted, and country. After gathering data from the first 9 cases (3 for each PSS category) we added an additional case (PSS\_10) of a Product-Oriented PSS, in order to have a second case with circular economy implementation and a complete sample: 4 Product-Oriented, 3 Use-Oriented and 3 Result-Oriented cases.

In order to ensure coherence and consistency, a standard interview protocol was developed to guide interviews. The guidelines were structured in five main sections:

1. Description of the PSS offering(s) and of related business model(s);
2. Considerations of a strategic nature, to investigate the presence of competitive advantage attributable to PSS, and its constituting elements;
3. Description of the internal environment and considerations linked to elements such as awareness of PSS and its characteristics, resistance to change and key processes for PSS implementation/support;
4. Description of the external environment and considerations linked to elements concerning external stakeholders, as for instance customers, suppliers, partners, external sponsors, competitors;
5. Considerations on (eventual) future development of PSS offering(s) and related business model(s).

The research framework deriving from the above protocol will be explained in greater depth in section 4.

Case analysis was conducted following the recommendations of Yin (1984), Eisenhardt (1989), McCutcheon and Meredith (1993), and Miles and Huberman (1994). Within-case analysis was conducted according to coding techniques (adapted from Strauss, 1987; Strauss and Corbin, 1990). Cross-case analysis was conducted according to Eisenhardt (1989), Runkel (1990), and Yin (1984), seeking matches, similarities, differences, and crossing variables, among cases, to maximize the validity and generalizability of the study.

Criteria of internal validity, construct validity, external validity, and reliability were taken into account, according to Cook and Campbell (1979), Yin (1984), Eisenhardt and Graeber (2007), and are schematized in Table 2.

**Table 2. Validity and reliability of multiple case studies**

Characteristics	Criteria
<b>Construct validity</b>	<ul style="list-style-type: none"> <li>• Data triangulation: use of primary data (retrieved through interviews) and secondary data (from archival evidence)</li> <li>• Review of transcriptions by co-authors and key informants</li> <li>• Explanation of data analysis procedures</li> </ul>
<b>Internal validity</b>	<ul style="list-style-type: none"> <li>• Research framework derived from literature</li> <li>• Theory triangulation - use of different theoretical lenses: resource-based view, competitive advantage, sustainability (circular economy)</li> </ul>
<b>External validity</b>	<ul style="list-style-type: none"> <li>• Cross-case analysis (multiple case studies)</li> <li>• Rationale for cases selection: theoretical sampling</li> </ul>
<b>Reliability</b>	<ul style="list-style-type: none"> <li>• Adoption of an interview protocol</li> <li>• Development of a case study database</li> </ul>

First, we performed a within-case analysis, in order to test and verify the accuracy of three distinctive sets of factors identified through literature analysis (Section 2.2), and understand their influence and capability of explaining PSS's characteristics. After that, we used the factors to perform a cross-case analysis in order to allow comparisons between different PSS's implementation contexts.

Figure 1 presents the overall research framework, moving from research questions to the final theory building effort.

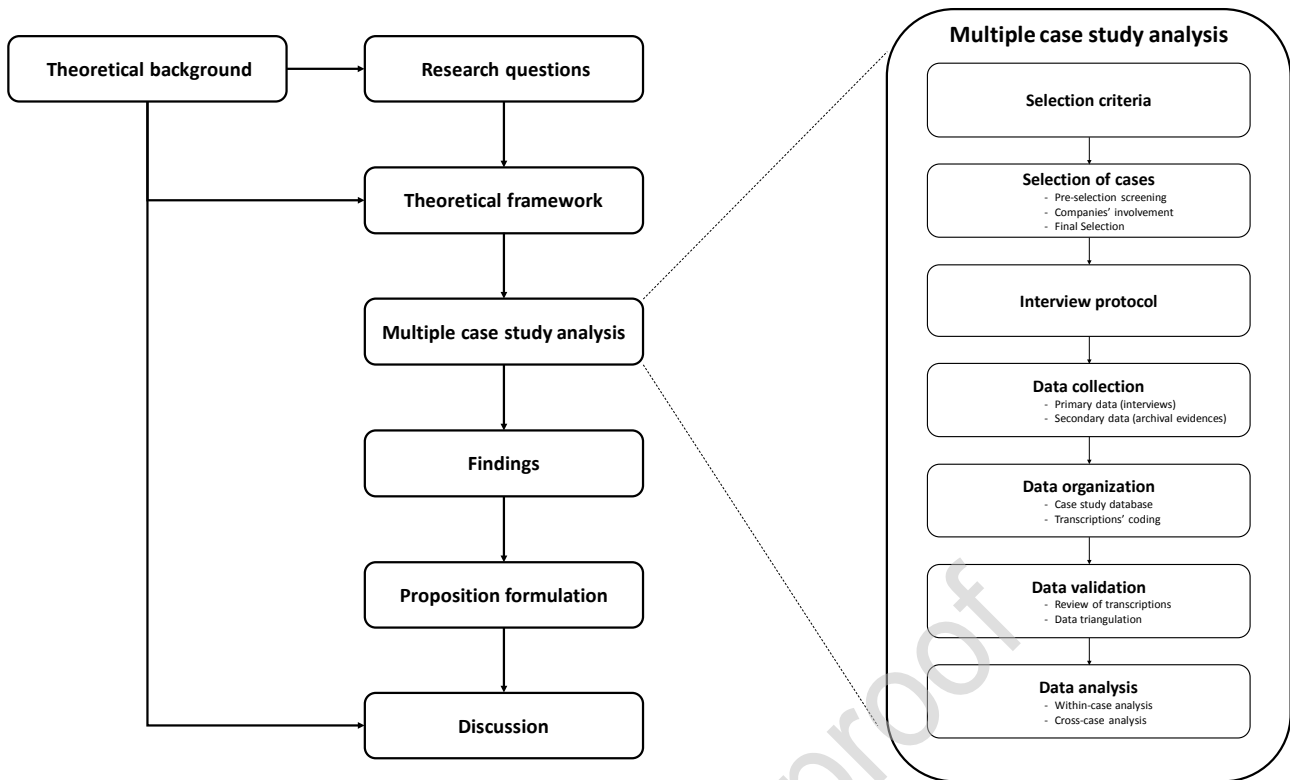


Figure 1. Research framework (research methodology detail)

## 4. Findings and discussion

### 4.1. Types of PSS, market segmentation and competitive advantage

One of the main advantages in investigating companies differing on the basis of many elements (such as industry, dimension, and core business) was that of uncovering differences in performance attributable to one or more of these characteristics. In conducting interviews, it was necessary to understand if PSS was a consolidated reality or was likely to be discarded from a firm's set of strategic choices, because analysing cases of failure was as important an element of the research as examining successful ones.

For what concerns the Type of PSS, deriving market segmentation and the presence of Competitive advantage, which is the main variable of analysis, we found that:

- The first PSS analysed (PSS\_1) is a Product-Oriented offering, employed by a firm selling modular carpets and operating in a B2B context: the company sells modular carpet tiles to its customers, including an all-encompassing series of services like installation, maintenance, substitution, removal and recycling, and maintains a traditional relationship of seller-buyer with customers. The manager interviewed (The Vice President of the Product and Innovation Department) clearly recognized the PSS as a source of competitive advantage, thanks to some important services like take-back programs involving the dismantlement and recycling of end-



of-life products. The same firm as PSS\_1 offers this PSS too, and both share many characteristics.

- PSS\_2 is a Result-Oriented offering, where clients lease services of a modular carpet system without taking ownership or liability for maintenance: the system comprises the entire series of services presented in PSS\_1 (installation, maintenance, substitution, removal, recycling), including an extra design service, in order to meet customer's needs more specifically. Although this offering shares many characteristics with PSS 1, it proved to be an unsuccessful offering, with a very small number of customers since its launch: according to the manager, this is probably due to the leasing formula that proved to be unattractive for customers, and discouraged instead of attracting them.
- PSS\_3 was offered by a company that provides white goods in a B2B market, specifically focusing on business laundry services and food services. These services are the core of the Product-Oriented offering and include education, management of usage information (to reduce downtimes), financing options, maintenance and spare parts provision. According to the interviewee (Manager of The Service Department), this PSS does not constitute a competitive advantage, as it does not enable the company to outperform its competitors.
- PSS\_4 is a Use-Oriented PSS, consisting of a bike-sharing service based in the biggest Italian cities. Operating in the out-of-home advertising and marketing sector, the firm launched the PSS offering in order to expand its advertising in new directions. It exploited the high success and popularity of alternative means of transport, and based itself on the concepts of sharing and environmental sustainability. This PSS creates an important competitive advantage for the firm, which is, however, mainly attributable to the advertising opportunities offered by the bike-sharing business model.
- The analysed company for PSS\_5 sells forklift trucks and warehouse equipment, mixed with a series of services in a Product-Oriented PSS. These services include education, management of usage information (to reduce downtimes), financing options, maintenance and spare parts provision. These services are no longer considered a source of competitive advantage, which is due to their nature, as they are regarded by the market as a necessary feature. Their provision brings no advantage, but their lack would result in an important disadvantage for the company.
- PSS\_6 is a car-share offering (Use-Oriented) provided by a small Italian company operating in a local/regional area. It originated as a joint venture of different local firms, who recognized the great potential of a car-share offering, especially as it is offered in a mountain area a. The interviewee (Fleet manager) acknowledged that this car-share offering has received an enthusiastic response from market, with a rising number of private and business users

subscribing and regularly using the service. Because this firm is the only one offering a car-sharing service in the region, there is not enough evidence to identify the presence of a competitive advantage, though Goedkoop et al. (1999) acknowledged in their study that a car-sharing PSS implies a major efficiency in value creation (for users) and environmental capacity, granting PSS an advantage in competing with the traditional sale of cars, thus giving it the basis for a clear and well defined competitive advantage.

- PSS\_7 is a Result-Oriented offering focused on the provision of Internet of Things (IoT) solutions to its customers in a B2B market. The manufacturing company expanded its original business model as part of an expansion plan aimed at exploiting new chances offered by cloud technologies, so as to differentiate the firm from its competitors and to benefit from first mover advantage. Thanks to IoT technologies, the firm gained a privileged position in the market: this is mainly due to superior levels of efficiency and effectiveness offered to customers, because new technologies allow the company to understand and monitor its products in real time, while ensuring a constant and efficient series of services (above all assistance) to its clients.
- In the case of PSS\_8, the ICT company offers tailored solutions for clients, based on server usage and related services (Result-Oriented model) in a B2B market. Even though the market is frequently subject to discontinuities, this PSS is part of a wider expansion plan, which sees the firm as evermore projected toward selling solutions and services rather than physical products as in the past (the mere selling of products in this segment should disappear in a few years). Despite the high level of service ensured to customers, this offering cannot be considered a source of competitive advantage since by now this model is a standard and a necessary feature to survive against competitors; despite this, the offering is capable of generating a considerable net value for the company, thanks to revenues deriving from service components of the offering.
- The Use-Oriented model employed for PSS\_9 focuses on the management of coworking spaces for startups linked to technology and ICT markets. Startups can share common places for work in a collaborative environment and benefit from the presence of other similar companies, or rent private spaces such as offices and meeting rooms. The payment formula is based on monthly fees, which also gives clients access to the entire network of spaces located in different Italian and European cities. The presence of a network of spaces available for customers gives the company a privileged position over its competitors.
- PSS\_10 consists of the selling of a modular smartphone with extra services added (Product-Oriented model), such as spare parts provision and collection at the end of a product's life

cycle (or when the customer wants to change their smartphone). The distinction of this offering is ensured by its strong (environmental and even social) sustainability concern and by the modular nature of the product: despite a positive response from the market (B2C and B2B), the company cannot benefit from a considerable marginality of products sold, because ensuring “fairness” and sustainability caused a considerable growth in costs. Nevertheless, since the launch of the offering the company has experienced a rising trend of products sold, which will ensure considerable returns after a threshold level of sales is reached.

#### 4.2. *PSS’s core resources/competences/organizational processes and competitive advantage*

Looking more in detail at the core determinants of competitive advantage, identified in resources/competences/processes and the degree of protection from replication, what emerged from the analysis of cases is that:

- PSS\_1 and PSS\_2: The most important source of competitive advantage was recognized as the series of processes (P) involving an entire reconfiguration of the supply chain. In order to implement take-back logistics and recycling facilities in the firm’s value chain, the company faced considerable investments to find and to involve new partners/suppliers and, also, to redefine relationships and contracts with existing ones; this allowed the company to secure key sources of competitive advantage (hard replication for competitors, *Protection from replication* score = 1). Although resources (R, mainly logistic infrastructures) were considered quite easy to replicate, they were classified as exposed to a medium replication risk (*Protection from replication* score = 0.5), because the protection from replication can be mainly attributed to the considerable investment required and to first mover advantage, from which the analysed company benefitted. Technical competences (C) required for PSS design and setup were non-distinctive and easy to be retrieved on the market and therefore were classified as easy to replicate (*Protection from replication* score = 0).
- PSS\_3: The most important elements of the PSS considered was recognized to be resources (R), mainly consisting in service infrastructure, together with organizational processes (P), ensuring a widespread presence in the area and an excellent quality of maintenance services. Competences (C) are not considered as a key element of this PSS offering and they can easily be retrieved by competitors, making them easily replicable (*Protection from replication* score = 0); the service infrastructure, although it is an important element of PSS, has been judged as easy to replicate since there are no distinctive and/or characteristics elements behind it and also there are no specific agreements with suppliers and partners (*Protection from replication* score = 0), while the distinctive organizational processes are part of the company’s tacit

knowledge, and this ensures a strong protection from replication by competitors, since competitive sources are bound within the organizational structure (*Protection from replication* score = 1).

- PSS\_4: Although competences (C) were acknowledged as a valid investment, they are not considered a key element of PSS's success, and, like previous cases, they are easy to retrieve (*Protection from replication* score = 0). Conversely, resources (R) and processes (P) are felt to play an important role in this PSS offering. The formers are closely related to investment in R&D to develop hardware and software components; the latter consist of an entire series of new organizational processes specifically developed for the bike-sharing PSS, which positively affected also the other activities of the company. Both these elements represent a hard obstacle to replication by competitors, since they have been developed and realized to be closely linked to (and therefore, valuable for) the specific organizational structure of the analysed company and its offering (*Protection from replication* score = 1). It seems that the implementation of the bike-sharing offering, and consequently the response from the market, were strongly affected by its "success story".
- PSS\_5: Service infrastructure (R) and dedicated human resources (C) constitute important elements, despite the fact that they are recognized as quite easy to replicate, given their non-distinctive nature and the ease with which they can be retrieved by other companies operating in the same market (*Protection from replication* score = 0). As regards processes (P), the Service Quality Evaluation procedures, connected to the distinctive organizational culture of the company, are the true key element of this PSS, and also constitute the greatest obstacle for competitors wishing to replicate this business model (*Protection from replication* score = 1).
- PSS\_6: The interviewee clearly identified, as key elements of their offering, resources (R) and organizational processes (P). The resources are mainly comprised by their fleet and everything related to its activity and maintenance, and physical and service infrastructure; however, the, organizational processes are the true core of this PSS, because they include all the processes to manage the renting system, the relationships with customers, and the relationships with a considerable number of partners. Indeed, the company faced relevant investments in the creation of an entire set of partnerships and agreements with key suppliers to create the PSS business model and related offering, which nowadays constitute a serious barrier to entry and obstacle to companies willing to compete on this market by replicating the offering. The competences (C) were evaluated as non-specific and easily retrievable (*Protection from replication* score = 0), while the resources required a considerable

investment which can be considered the major obstacle to replication (*Protection from replication* score = 0.5). However, the processes were the component that was the most important and hard to imitate, being the core of the company culture and part of its tacit knowledge (*Protection from replication* score = 1).

- PSS\_7: The implementation of the considered PSS offering required no investment in additional resources (R) (physical and technical resources), since it is based on pre-existing offerings, which constitutes no obstacle for replication from competitors (*Protection from replication* score = 0); conversely, it required considerable investment in new competences (C), to hire new specific human resources and start training and educational programs to update existing competences, since these resulted to be distinctive and hard to be retrieved on the market (*Protection from replication* score = 1). Moreover, PSS adoption required also substantial modifications and the update of internal processes (P), so as to include cloud technologies (which had been unused before) and exploit IoT potential; this resulted in the creation of a unique set of interacting elements that define and characterize the company's offering, being a non-negligible element of it, although it would be hardly replicated by competitors (*Protection from replication* score = 1). The advantage granted by this offering mainly lies in customization chances offered by the integration of IoT technologies in the manufacturing context in order to give customers tailored solutions for their needs.
- PSS\_8: As regards the resources (R), the PSS required no additional investment, since the offering is based on existing products and services, but there was a need for new competences (C), retrieved through new assumptions and training and educational programs. Both resources and competences, even if they required investments to be retrieved/built, have been evaluated as non-distinguishing elements of the offering, because of the relative ease of replicability, mainly deriving from their non-specific nature (*Protection from replication* score = 0). Organizational processes (P) were identified as the most important element behind the PSS model, because the way in which processes and people interact to create tacit knowledge and organizational routines is the real distinctive characteristic of the offering, and is almost impossible to replicate (*Protection from replication* score = 1).
- PSS\_9: Physical resources (R) mainly consist in spaces and settings, which can benefit from a distinctive design that can be recreated by companies willing to imitate the offering, even if with some difficulties (*Protection from replication* score = 0.5), while competences (C) behind the overall organization of PSS offering are not distinctive, even if they constitute quite an important intellectual capital and knowledge asset of the firm (*Protection from replication* score = 0.5). The real distinctive element behind the success and competitive

advantage of the considered PSS are organizational processes (P) and the presence of a network: this required important investments in creating a network of interrelated work spaces that are all part of the same offering, and even if there are other companies operating and competing in the same market, they could not replicate so far this network that allows customers to benefit from different spaces in different cities and countries (*Protection from replication score = 1*).

- PSS\_10: PSS introduction required considerable investment in physical solutions that, even if not specific and distinctive, would require competitors a considerable investment to be replicated (R, *Protection from replication score = 0.5*) and the same can be said on investment in specialised competences (C) that, moreover, are also specific and distinctive given the need of figures with a hard technological background, making it even harder for competitors willing to imitate and recreate the offering and the whole business model behind (*Protection from replication score = 1*). Even though PSS introduction also required changes in organizational processes (mainly to implement reverse logistics processes and B2B sale channels) these are not distinctive elements of the considered offering (P, *Protection from replication score = 0*). Although the firm is not able at the moment to generate a considerable sales volume, it can benefit from the creation of a niche and from the exploitation of sustainability and circular economy concepts.

Table 3 summarizes the value of variables emerging from the within-case analysis.

**Table 3. Value of variables investigated for each PSS**

	<i>Competitive Advantage</i>	<i>Type</i>	<i>Drivers</i>		
			<i>Core factors</i>		<i>Protection from replication index</i>
<b>PSS_1</b>	PSS is a source of competitive advantage, thanks to some important services like take-back programs involving the dismantlement and recycling of end-of-life products	PO	Resources		0.5
			Competences		0
			<b>Processes</b>	+	<b>1</b>
<b>PSS_2</b>	PSS proved to be an unsuccessful offering, attracting a very small number of customers since its launch.	RO	Resources		0.5
			Competences		0

			<b>Processes</b>	+	<b>1</b>
<b>PSS_3</b>	According to the interviewee (Manager of The Service Department), this PSS does not constitute a competitive advantage, as it does not enable the company to outperform its competitors.	PO	<b>Resources</b>	+	0
			Competences		0
			<b>Processes</b>	+	<b>1</b>
<b>PSS_4</b>	This PSS creates an important competitive advantage for the firm, which is, however, mainly attributable to the advertising opportunities offered by the bike-sharing business model.	UO	<b>Resources</b>	+	<b>1</b>
			Competences		0
			<b>Processes</b>	+	<b>1</b>
<b>PSS_5</b>	These services are no longer considered a source of competitive advantage, which is due to their nature, as they are regarded by the market as a necessary feature. , Their provision brings no advantage, but their lack would result in an important disadvantage for the company.	PO	Resources	+	0
			Competences	+	0
			<b>Processes</b>	+	<b>1</b>
<b>PSS_6</b>	This car-share offering has received an enthusiastic response from market, with a rising number of private and business users subscribing and regularly using the service.	UO	<b>Resources</b>	+	<b>0.5</b>
			Competences		0
			<b>Processes</b>	+	<b>1</b>
<b>PSS_7</b>	Thanks to IoT technologies, the firm gained a privileged position in the market: this is mainly due to superior levels of efficiency and effectiveness offered to customers	RO	Resources		0
			<b>Competences</b>	+	<b>1</b>
			<b>Processes</b>	+	<b>1</b>
<b>PSS_8</b>	Despite the high level of service ensured to customers, this offering cannot be considered a source of competitive advantage since by now this model is a	RO	Resources		0
			Competences		0

	standard and a necessary feature to survive against competitors		<b>Processes</b>	+	<b>1</b>
<b>PSS_9</b>	The PSS is encountering an enthusiastic response from different companies, who can share common places for work in a collaborative environment and benefit from the presence of other similar companies, or rent private spaces such as offices and meeting rooms.	UO	Resources		0.5
			Competences		0.5
			<b>Processes</b>	+	<b>1</b>
<b>PSS_10</b>	The distinction of this offering is ensured by its strong (environmental and even social) sustainability concern and by the modular nature of the product, generating a positive response from the market (B2C and B2B).	PO	Resources		0.5
			<b>Competences</b>	+	<b>1</b>
			Processes		0

#### 4.3. Protection from replication and competitive advantage

Data gathered through interviews and synthesized in the previous section, allowed us to perform cross-case analyses and evaluate differences and similarities among cases according to different variables, with a specific focus on the effects of *protection from replication*.

Cases were compared in order to highlight the effects that relevant elements (taken from RBV) of Competitive Advantage can have in combination with PSS categories (which represent specific market segmentations). The tables above present two different situations: in the first one all relevant elements have been considered, with no intent to consider the protection from replication threat; in the second one, only relevant competitive elements that had some protection from replication (score equal to 0.5 or 1) have been taken into account.

Table 4 depicts the first situation where protection has not been taken into account.

**Table 4. Relevant core factors and PSS categories (no protection from replication considered - positive cases highlighted).**

	Presence of CA			Absence of CA		
Resources		PSS_4 PSS_6		PSS_3 PSS_5		
Competences	PSS_10		PSS_7	PSS_5		



<b>Processes</b>	PSS_1	PSS_4 PSS_6 PSS_9	PSS_7	PSS_3 PSS_5		PSS_2 PSS_8
	<b>PO</b>	<b>UO</b>	<b>RO</b>	<b>PO</b>	<b>UO</b>	<b>RO</b>

As shown in the table above, the positive effect of Resources and Process for UO PSSs and of Competences for RO PSSs are not counter-balanced by negative examples of unsuccessful PSSs, unlike the other cases. The contrasting results do not allow us to make other inferences as, for instance, in the analysis of the effect of Competences for PO PSSs (PSS\_10 compared to PSS\_5). However, the results that emerged from the previous considerations allow us to formulate the following propositions:

*P1: Use-Oriented PSS business models gain a competitive advantage from physical resources and organizational processes, whether protected against replication threat or not.*

*P2: Result-Oriented PSS business models gain a competitive advantage from people competences, whether protected against replication threat or not.*

In the following, only competitive elements with a protection from replication were considered in order to perform a more refined analysis and to highlight any additional positive effect coming from this strategic leverage. In Table 5, we report these elements and highlight the results.

**Table 5. Relevant core factors and PSS categories (with protection from replication considered).**

	Presence of CA			Absence of CA		
<b>Resources</b>		PSS_4 PSS_6				
<b>Competences</b>	PSS_10		PSS_7			
<b>Processes</b>	PSS_1	PSS_4 PSS_6 PSS_9	PSS_7	PSS_3 PSS_5		PSS_2 PSS_8
	<b>PO</b>	<b>UO</b>	<b>RO</b>	<b>PO</b>	<b>UO</b>	<b>RO</b>

In the above situation, we can see how, in the presence of protection from replication, the positive influence of Competences over PO PSSs emerges across different cases, while two contrasting results across our cases remain, so no additional inferences can be made. Therefore, the above evidence leads us to confirm the previous propositions P1 and P2, and even formulate a third one:

*P3: Product-Oriented PSS business models gain a competitive advantage from people competences only if protected against replication threat from competitors.*

#### **4.4. Discussion**

Drawing upon the cases analysed, what emerged is that the employment of PSS in emerging industries, like those exploiting sharing economy concepts (e.g. sharing mobility), has proved to be a successful competitive and strategic move in all organizations, across different business models and PSS categories. For example, firms running Use-Oriented offerings, although presenting different offerings, all encountered a good response from customers, showing that the most successful element lies in the sharing concept, together with processes and resources provided for PSS implementation (proposition P1).

Firms wanting to exploit possibilities linked to sharing economy concepts through Use-Oriented business models should focus on users' requests, so as to build the offering around their core needs: as already shown, the most important element for a successful implementation of this type of offering lies in meeting customers' needs. For instance, the success of the offering of PSS\_9 company clearly exemplifies this finding: the company, offering co-working spaces, focused on one of the most important aspects for its customers, which is the availability of different spaces and solutions in different cities in Italy and abroad, together with a friendly and functional environment with the same characteristics in all venues.

Of course, processes and resources must be defined accordingly so as to exploit their competitive potential in the best possible way, since they can be seen as the operative levers that allow companies to translate the PSS concept into a practical offering. Following the previous example of PSS\_9, understanding and then exploiting the role of resources and processes (the key element in the offering) is what allowed the company to focus the PSS on a consistent value proposition. On the basis of the evidence from the literature and the market, sharing mobility constitutes the most interesting and developed example of a Use-Oriented PSS: recalling what was said by the Fleet manager for PSS\_6, in conceiving and developing a car-, bike-sharing offering, public transport must be perceived not as a competitor, but as a complementary resource. Not doing so would imply a bigger effort to cover a larger territory and serve a larger number of customers, and this would involve more resources and higher costs, due to larger investments that would be required in creating a larger fleet to meet the demand. As reported in the case of PSS\_4, which proved to be the most successful among those analysed, implementing a bike-sharing offering requires a great deal of effort, in terms of investment for resources and in terms of "making the overall system work" through the development and implementation of effective organisational processes. The cases analysed proved that the combination

of these two elements allows companies to gain a favourable competitive position, but nonetheless this implies an amount of effort and investment. Indeed, investments are needed in order to retrieve resources on supply markets, and organizational processes are needed as well to extract as much value as possible from these resources. The lack of one of these two elements would imply a failure in successfully delivering the PSS to the market. New organizational processes, specifically built around the PSS offering, allowed the company analysed to build an important competitive advantage also deriving from advertisement services linked to bike sharing. Furthermore, it has to be highlighted that understanding who the competitors and complementary firms really are is not truly a key aspect in this type of offering since the aspect of protection from replication is not a distinctive feature characterizing Competitive Advantage in the case of Use-Oriented PSSs.

On the other hand, companies operating in more traditional industries like firms selling carpet tiles and those employing an Engineer-to-order approach, showed some important constraints in running a PSS, and this can be linked to external causes like the customers' resistance to change and lack of trust in an offer where they do not buy the product but only its use. Result-Oriented offerings mainly proved to be disadvantaged by this and by lack of trust, even in B2B contexts (like that of PSS\_2) where the consumer experience should be a minor aspect if compared to B2C markets. This becomes particularly clear when considering the lack of influence of organisational processes and resources for competitive results of Product- and Result-Oriented PSSs (Table 4 and Table 5). In several B2B markets, the success of an offering might depend exclusively on its rationale and how convenient offer can be for potential customers. Investing in elements (like resources) to build an "attractive" offering, so as to focus on the value proposition for instance, proved to be not a successful strategic move, while it might be more consistent to invest in human resources and competences (to focus more on key activities, partnerships, and sale channels) on which companies might build a more concrete PSS bringing to competitive advantage.

The *Protection from replication* factor, as reported in proposition P3, proved to be a key element in ensuring the competitive relevance of competences for Product-Oriented PSSs, a finding that confirms what was stated in the framework section concerning the adoption of this indicator as a means to evaluate the economic sustainability of competitive advantage over time, as outlined in Teece *et al.* (1997). Competences are closely related to human resources and the tacit knowledge they carry, which might be seen as the competitive factor with the highest chance of being acquired (or "moved") from a competitor. Indeed, losing a key human resource/competence is more likely to invalidate investments in specific resources and/or organizational processes that without competences and tacit knowledge might lose their intrinsic value.

Furthermore, competences proved to be a crucial element also for the competitiveness of Result-

Oriented PSSs (P2), and in this case their role is even stronger, since in the considered cases no need emerged for companies to clearly ensure the protection from replication of these intangible resources. This is even more relevant considering that the Result-Oriented category is mainly focused on B2B markets and channels, and is more likely to be developed in technology-intensive industries: these two characteristics have the double effect of confirming and strengthening the findings related to this category of PSS.

One last consideration concerns the concept of customer perception: this appears to be a key element in ensuring the successful implementation of a PSS, and is strongly affected by “success stories”. For example, a similar PSS business model, adopted elsewhere, and known to have experienced a good response from customers, can positively affect the adoption and acceptance of the same model in other markets. This is, for example, the case of car-sharing, whose acceptance has been, and still is, strongly affected by its earlier and successful adoptions, like those in northern European countries. The manager interviewed for PSS\_4 (Bike-Sharing Director) reported that the introduction of the bike-sharing system in Italy and other European countries followed its first successful implementation in Norway: this experience strengthened commitment to the model inside the organization and, more importantly, affected acceptance by customers. Indeed: “the success of a bike-sharing offering can vary a great deal according to the place where it is implemented: in the U.S., mainly because of a different cultural attitude toward bicycles as a means of transport, the response from the market was very limited, while in Europe there has been a more enthusiastic response from customers. Implementing a successful bike-sharing model is quite a hard challenge, because of the high level of costs and because of problems linked to the organizational and managerial aspects of the overall system. Thanks to the successful implementation in Norway (and subsequently in other Northern European countries, A/N) since the end of 1990s, we have been able to adopt the same model in many other countries and cities without problems.” (extracted from the interview)

## **5. Conclusions**

This research provides interesting insights in the investigation of PSS potential in constituting a competitive advantage, not through forecasting performance, as in the literature, but through an in-depth analysis of strategic and competitive results. The analysis focuses on PSS implementation in different countries, different markets, and firms of different sizes and running various categories of PSS. Thanks to these various levels of analysis, it is possible to analyse PSS impact on business considering some key competitive elements.

Following the research gaps previously identified, we addressed the issues of cases stratification and adopted a backward perspective on PSS implementation. Indeed, compared to previous works

that focused on manufacturing sector (Azarenko *et al.*, 2009; Cook *et al.*, 2006; 2012), aerospace industry (Bankole *et al.*, 2012; Chirumalla *et al.*, 2013) or solar service systems (Friebe, 2013; Overholm, 2017), our study adopted a wider and stratified sample of cases. Cases investigated show also a relationship between competitive advantage and PSS-related offering based on sustainability. Companies have a competitive advantage also thanks to innovative and more sustainable offerings. This is especially true for successful offerings like PSS\_1 case, which includes services like take-back programs, dismantlement and recycling of end-of-life products, the PSS\_4 case (bike-sharing), PSS\_6 case (car-sharing) and PSS\_10 case (modular electronic goods). Accordingly, our research stresses once more the sustainable potential of PSS through companies' capability of addressing economic, environmental and social aspects of sustainability.

We investigated more in detail competitive aspects of PSS implementation, by studying the results brought by the introduction of PSS-related offerings. Indeed, previous works were more focused on other aspects than competitiveness, such as alliance formation (Overholm, 2017) or knowledge transfer (Cook *et al.*, 2006; 2012) while other works, focusing on competitiveness and strategic aspects, adopted different methodologies, i.e. literature reviews (Beuren *et al.*, 2013; Reim *et al.*, 2015).

For scholars, this work suggests a new perspective in analysing overall PSS performance and uncovers some "hidden characteristics" which had not emerged from past studies. In particular, moving from the gap found in literature, we structured our multiple case studies so as to include as much diversity and stratification as possible, in order to provide a meaningful cross-case analysis. We focused our Research Question on one of the most important aspects in analysing a business model: that of how to create value through competitive advantage and which factors determine it. As evidenced in the theoretical background, this aspect has received little attention in academic studies of PSS.

For practitioners, this research provides practical and useful considerations on PSS competitive and strategic potential, with an in-depth analysis of success elements. In particular, through the analysis of competitive advantage, its constituting elements (Resource, Competences and Processes) and their degree of *Protection from replication*, we were able to identify the characteristics capable of ensuring PSS performance leads to competitive advantage. Managers willing to implement a Product-Oriented PSS should keep in the importance of employing distinctive competences in mind on the condition that they be protected against replication in order to contribute to the competitive advantage. In case of Use-Oriented implementation, which proved to be the most successful PSS category, managers should be reminded of the importance of understanding the role of organisational processes and resources, together with their mutual interaction, since it is on these elements that the

distinctive nature of Use-Oriented offerings is built. Finally, for what concerns the Result-Oriented category it is important to remember the strategic importance of human resources and their competences. Nevertheless, from our within-case analysis it emerged that this type of business model is still not entirely acceptable to customers. The literature has expended considerable effort on demonstrating and promoting a Result-Oriented offering as a win-win solution (for customers and companies) and as the category of PSS with the highest results in terms of economic and environmental sustainability: despite this effort, the above business model seems to still require additional investment (not in terms of resources but in terms of advertisement) to become a well-accepted and successful offering in the market. This leads us to theorize a “dematerialization paradox” which managers should consider: indeed, in some cases, Result-Oriented offerings, although they do not require protection from replication for dedicated competences, appeared to be less attractive for customers compared with similar Product-Oriented offerings, which, on the other hand, require stricter competence conditions to be strategically successful.

Finally, we have to acknowledge the limits of our research: though producing some interesting results, these have emerged from a sample of firms that should be integrated with other multiple case studies and/or surveys, to confirm or confute our findings. Therefore, future studies on this aspect could involve a sample of firms operating in other industries and offering different PSSs.

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**Declaration of interests**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Journal Pre-proof

- This research investigates the conjoint effect of three potential sources of PSS's competitiveness
- We adopted a multiple case study methodology involving 10 cases
- PSS type, resources, competences and organizational processes represent key strategic factors
- Protection from replication of strategic key factors is vital for Product-Oriented PSSs

Journal Pre-proof